Multi-objective NSGA-II optimization of a compression ignition engine parameters using biodiesel fuel and exhaust gas recirculation

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ABSTRACT

In this study an exhaust gas recirculation system was developed for a small single cylinder 4-stroke engine. Then the mathematical models to correlate responses as the engine emissions and performance characteristics to the factors, include engine load, engine speed, EGR rate and biodiesel fuel percent, were developed. Finally, by using the developed models and NSGA-II (Non-dominated Sorting Genetic Algorithm II) method, the factors were optimized. The highest decrease in NOx emissions while using the biodiesel and EGR is 63.76% with B10 fuel blend (10% biodiesel fuel and 90% diesel fuel blend by volume) and 30% EGR rate. The highest reduction in HC emission levels while using EGR and biodiesel simultaneously, has been 54.05%. The adjusted R^2 of the proposed model for the CO, HC, NOx, Power, BSFC and smoke were 0.94, 0.91, 0.88, 0.95, 0.89 and 0.94, respectively. Results of the optimization of the engine factors with NSGA-II method has been satisfactory and the pareto front for different test conditions was proposed. The outcomes of the study revealed that the optimization should be taken into account in the development of the new policy for using of the biofuel in the internal combustion engines.

KEYWORDS

Multi-objective optimization; EGR; RSM; Emission

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